

Colorado Space Grant Consortium
University of Colorado at Boulder
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Colorado Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2012.

PROGRAM GOALS

The Colorado Space Grant Consortium had four primary goals for the year as part of a five-year strategic plan developed to enhance the overall student experience and better equip the student for the workforce.

These four primary goals were:

1. Increase diverse student participation in hands-on space hardware programs.
2. Sustain four stages of hands-on programs for COSGC students.
3. Create and support opportunities for COSGC students to work with engineers and scientists from Colorado aerospace companies.
4. Partner COSGC students and program with faculty and industry experts and their research through space hardware missions, seed grants, and research grant opportunities.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)

Outcome 1:

- Jessica Trujillo, University of Northern Colorado (UNC) senior, was hired by RoadNarrows Robotics directly as a result of her experience with the robotics project at UNC Space Grant.
- Zach Scott became the first student to participate in a pilot program designed to retain students in Space Grant programs across institutions – connecting community college students with 4-year institutions and programs. Zach transferred from Trinidad State Junior College (TJSC), where he participated in Space Grant robotics projects, to the University of

Colorado at Boulder (CU), where he is enrolled in Mechanical Engineering and is working on the Space Grant Polar Cube satellite mission.

- Jaime Corchado became the first student to participate in a new pipeline collaboration between Community College of Aurora (CCA) and Colorado School of Mines (CSM). The collaboration is meant to give students graduation from a community college and transferring to CSM summer research experience. As a result of his work with both CCA Space Grant and CSM, Jaime was selected to participate in an internship at Kennedy Space Center during the summer and fall of 2013. He is currently working toward his bachelor's degree and ultimately plans to complete an advanced degree.

Outcome 2:

Daniel R. Newmyer, science and math teacher at Center High School in rural southern Colorado, was selected by the Astronauts Memorial Foundation, NASA, and the Space Foundation (SF) as recipient of the 2013 Alan Shepard Technology in Education Award – given annually in recognition of creative and innovative use of technology by K-12 educators. Daniel is one of the Teacher Liaison's in the Space Foundation's Education program and was nominated by former NASA astronaut, Kent Rominger.

PROGRAM ACCOMPLISHMENTS

Goals stated as SMART Goal Metrics from the COSGC 2010 Proposal are indicated in parenthesis at the end of each line item - including the page number from the proposal where each may be located.

NASA Outcome 1:

COSGC Goal 1 (Diversity)

- All COSGC students who received scholarships participated in hands-on, space hardware programs at their respective institutions, or with industry partners.
 - **29%** of scholarships were awarded to women (Goal: 33.7%, p. 9)
 - **12%** of scholarships were awarded to minority students underrepresented in STEM disciplines. (Goal: 19.5%, p. 9)

COSGC Goal 2 (Fellowship/Scholarship & Higher Education)

- All COSGC institutions awarded a minimum of **30%** of their FY 2012 funding directly to students in the form of scholarship awards. (Goal: 30%, p.10)
- **194** scholarships were awarded to COSGC undergraduate and graduate students in FY 2012. All awardees were engaged in hands-on space focused projects including laboratory research, observatory explorations, robotics projects, short and long duration balloon payloads, sounding rocket payloads, CubeSat payloads, and low Earth orbiting satellite missions. (Goal: 45, p.10)
- **352** undergraduate and graduate students engaged in hands-on space focused projects as credit students, volunteers or in project-focused courses. (Goal: 120, p.16)
- COSGC maintained all four stages of the SHOP (Staged Hands-On Program) approach to student experiences within the COSGC academic network.
 - In FY 2012 all COSGC institutions of higher education facilitated hands-on, space focused student projects that fall within the *Staged Hands-On Program* approach to student experiences outlined in the COSGC Strategic Plan: **17** facilitated at least one

introductory (or “Walk”) level student project (Goal: 17, p.16); **4** facilitated at least one beginning/intermediate (or “Run”) level students project (Goal: 4, p.16); **2** facilitated one intermediate/advanced (or “Jump”) level project (Goal 2, p.16); and **1** facilitated an advanced (or “Fly”) level project.

COSGC Goal 3 (Research Infrastructure)

- **13** students participated in EduSourcing internships at Lockheed Martin, Black Sun Solar, and Southwest Research Institute. (Goal 4, p.12)

COSGC Goal 4 (Research Infrastructure)

- **0** seed grants were awarded to junior faculty for research at Colorado State University (CSU). (Goal: 4, p.12) [CSU seed grant program was discontinued with the reorganization of CSU Space Grant programming.]
- **4** COSGC institutions facilitated research projects for students to work in collaboration with industry and/or academic mentors. (Goal: 4, p.12)
- **12** students participated in research projects for credit or as volunteers. (Goal: 10, p.12)

NASA Outcome 2: (Precollege)

- **40** teachers participated in **6** weeks of training at the Space Foundation’s summer Space Across the Curriculum courses. (Goal: 170 teachers; 7 weeks, p.17)
- **0** pre-service teachers engaged in curriculum building activities. (Goal: 2, p.17) Note: There was a change of affiliate director at the proposing institution (Adams State College). The new AD changed the program accordingly, including shifting focus to undergraduate STEM students not pre-service educators. This was detailed in the 2011 Statement of Work.

NASA Outcome 3: (Informal Education)

- Students and faculty at Pikes Peak Community College (PPCC) are collaborating with the Colorado Springs Astronomical Society to provide observatory viewing and star parties throughout the year for local schools and the general public. A total of **100+** members of the general public (of all ages) attended the events. (Goal: 1 activity with 30 participants, p.18)
- **60+** COSGC undergraduate students facilitated **28** K-12 hands-on science and engineering activities, engaging **500+** young students. These service-learning efforts support hands-on programs in order to promote well-rounded COSGC graduates by engaging young engineers with the wider community. (Goal: 1 activity with 30 K-12 participants, p.18)

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:** Total FY 2012 awards = 194, all of which are categorized as Fellowship/Scholarship awards.
 - 24 awarded to minority students underrepresented in STEM fields
 - 57 awarded to women
 - 133 students are still enrolled in their degree programs
 - 18 students are pursuing graduate studies
 - 4 are employed in the aerospace industry
 - 23 are employed in K-12 academic field in STEM disciplines

- **Diversity:**
 - COSGC includes:
 - 4 Minority Serving Institutions (MSI)
 - 5 two-year colleges
 - 3 four-year baccalaureate colleges
 - 3 four-year baccalaureate through masters institutions
 - 5 universities through PhD
 - 1 non-profit organization
 - 29% of 194 scholarships were awarded to women
 - 12% of 194 scholarships were awarded to minority students underrepresented in STEM disciplines.
 - 80% of 194 scholarships were awarded to undergraduate students
 - Of the 352 students participating in Higher Education projects, who did not receive fellowship/scholarship awards:
 - 22% were women
 - 14% were students from populations underrepresented in STEM disciplines
 - Of 51 faculty involved:
 - 27% were women
 - 6% were underrepresented
- **Minority-Serving Institution Collaborations:** COSGC has 4 MSIs engaged as active members of the consortium: Adams State University (ASU), Community College of Denver (CCD), Pueblo Community College (PCC) and Trinidad State Junior College (TSJC). Each of these institutions received 2012 funding to support hands-on programs on their campuses. All institutions participated in the 2012 COSGC Annual Meeting. In addition, students from all institutions participate in statewide COSGC programs (Colorado Robotics Challenge and DemoSat). ASU has been the organizing entity, with significant contributions from CU, for the Colorado Robot Challenge, which is celebrating its 7th year in 2013. The COSGC Lead Institution provides workshops for students to learn basic robotics skills as a “kick-off” to their semester projects, facilitates regular reviews for students participating in the DemoSat program, as well as launch opportunities for student payloads. In addition, student teams have access to CU testing facilities. Finally, students and faculty are encouraged to call the staff at CU for technical support and mentorship during space hardware projects.
- **NASA Education Priorities:**
 - a. **Authentic hands-on student experiences in science and engineering.**
 - **STATEWIDE EFFORTS:**
 - Students at 8 COSGC campuses participated in the Colorado Robotics Challenge by designing and building autonomous robots: Adams State University (formerly Adams State College), Colorado Mesa University (formerly Mesa State College), Trinidad State Junior College, Colorado State University, University of Northern Colorado, Community College of Aurora, Pueblo Community College, Colorado State University – Pueblo, and Fort Lewis College.
 - Students at 11 COSGC campuses participated in the statewide DemoSat program – building short-duration balloon payloads: Pikes Peak Community College, Trinidad State Junior College, Colorado State University, Colorado School of Mines (4 teams),

- Community College of Denver (2 teams), Metropolitan State University of Denver (8 teams and formerly Metropolitan State College), University of Colorado at Boulder (12 teams), Pueblo Community College, Fort Lewis College, Western State Colorado University, and Community College of Aurora (4 teams).
- Students at **8** campuses participated in robotics workshops facilitated by the COSGC Lead Institution in fall 2012 at different locations across the state.
 - Students from **9** campuses participated in the annual Colorado Space Grant Undergraduate Space Research Symposium. Students (either in teams or individually) submit research papers that are reviewed by judges from industry. Students then present their research. Students also participate by completing posters and/or hardware demonstrations for industry judges the day-of the Symposium.
 - WESTERN STATE COLORADO UNIVERSITY (FORMALLY WESTERN STATE COLLEGE):
 - One student partnered with female faculty member to work on an anomalous refraction research project – the student becoming an expert in telescope operation, use of CCD cameras and related software.
 - 8 students participated in a robotics workshop in Durango. The students then created a team to participate in the statewide robotics challenge and are working on a robot for the April 2013 Colorado Robotics Challenge.
 - In April, a team will be starting the astronomical observing season and return to the work on exoplanet transit observations, pending a new telescope.
 - UNIVERSITY OF NORTHERN COLORADO:
 - Eleven students are continuing work on a “mousebot” platform. Their long-term goal is to develop a platform that can be used for various applications by college students (class related) and to expand to more complex robots in future semesters.
 - Students presented a research poster at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
 - UNIVERSITY OF COLORADO AT COLORADO SPRINGS:
 - Students at UCCS continue the development of a motion capture platform to contribute to the on-going human motion research – including low gravity movement.
 - Students submitted a research paper at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
 - UNIVERSITY OF COLORADO AT BOULDER:
 - Students designed, built, and launched (September 2012) a long-term, high-altitude balloon payload (called HELIOS) in collaboration with the Center for Astrophysics and Space Astronomy as part of the LASPACE HASP program.
 - A team of students began work on the next CU HASP payload in November 2012, which is scheduled to launch September 2013, as a follow-on to the HELIOS mission.
 - CU students and staff manage the RockSat-C and RockSat-X launch programs in close collaboration with NASA Wallops Flight Facility (Wallops) working with universities across the nation; 15 in 2012 and 17 in 2013.
 - CU students launched a payload on the September 2012 RockSat-X launch at Wallops Flight Facility. Two student teams started work on two more RockSat-X payloads in January 2013. These are schedule for launch in August 2013.
 - Staff and students at CU coordinated and facilitated the 2012 RockOn! Workshop in collaboration with Wallops and Virginia Space Grant Consortium with 42 college

- faculty and students from 30 different college and universities. The team continues work on the 2013 RockOn! Workshop scheduled for June 2013.
- Students continue work on the DANDE satellite mission. CU students and faculty delivered DANDE to the Air Force Research Laboratory (AFRL) in Albuquerque, NM in July 2012 for a launch into orbit in summer 2013 aboard a SpaceX Falcon 9. Mission operations preparations are currently underway by a CU student team.
 - CU Space Grant facilitated the freshman level Gateway to Space course for 64 CU students. Students work in teams to develop a BalloonSat mission through proposal, build, test, launch, and data analysis.
 - A student team is working on the new PolarCube mission (CubeSat) through AFRL's University NanoSat-8 program.
 - The MiniCam student balloon payload mission will launch in April 2013. The project is proving some of the technology that will be used in the PolarCube mission and partnership with the National Snow and Ice Data Center.
 - The ALL-STAR student CubeSat mission continues toward a late 2013 launch in collaboration with Lockheed Martin and NASA's ELaNa program.
 - Two student teams are working on enabling mission operations through development and implementation of a ground station within the CU Space Grant facility and at a remote station near campus.
 - Several student teams presented a research papers and/or posters at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
- TRINIDAD STATE JUNIOR COLLEGE:
 - A student team is working on a robot for the Colorado Robotics Challenge in April 2013.
 - Several TSJC students have participated in various outings to photograph astronomical objects including the Transit of Venus, Jupiter, the Sun and various stars. The spring Astronomy class will photograph more objects including the Crab Nebula and the Andromeda Galaxy.
 - A three-student team is building a balloon payload to measure the conductivity of air as a function of altitude that will launch with the DemoSat program in April 2013.
 - Two student teams presented a research paper and poster at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
 - PIKES PEAK COMMUNITY COLLEGE:
 - A team of PPCC students is working on a BalloonSat payload that will launch with the April 2013 DemoSat program.
 - PUEBLO COMMUNITY COLLEGE:
 - A student team is working on an autonomous robot for participation in the Colorado Robotics Challenge in April 2013.
 - A student team is working on a BalloonSat payload that will launch with the DemoSat program in April 2013.
 - PCC students are machining parts for student projects at several COSGC affiliate institutions, including University of Colorado, Boulder (CubeSat mission), Colorado State University – Pueblo (Mars Fuel Production Research), Community College of Aurora (BalloonSat mission), and the Space Foundation (refinishing exhibit).—providing real-world customers for students learning to machine .

- Students presented a research paper and hardware demonstration at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
- COLORADO STATE UNIVERSITY – PUEBLO
 - Students continue work on the Sabatier reactor, exploring the creation of fuel for a return trip from Mars. The team presented a paper at the 15th annual Mars Society Convention.
 - A student team designed and tested a new design for a Lander that could be used to carry an autonomous rover during a DemoSat flight.
 - A student team is working on an autonomous robot for participation in the 2013 Colorado Robotics Challenge.
- COLORADO STATE UNIVERSITY - FORT COLLINS
 - Students work in teams to build autonomous robots for the Colorado Robotics Challenge.
 - Two student teams participated as summer interns: 1) developed a semi-autonomous Quad-copter capable of hovering and obstacle avoidance; and 2) developed a payload for capturing air samples at predetermined altitudes (BalloonSat).
 - A senior design team is developing a pressure and temperature controlled gas-flow system for use with a laser-based CO₂ sensor. This activity supports NASA ASCENDS missions and collaborates directly with NASA Langley.
 - Graduate level research is supported as well, as one student helps manage the CSU Space Grant program and also conducts NASA-related propulsion research.
 - Two student teams presented a research paper and poster/hardware demo at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
- COLORADO SCHOOL OF MINES
 - Student research project investigated the structure of Martian faults in order to better approximate age.
 - Another student research project ran laser induced breakdown spectroscopy to measure surface contaminants on a Mars sample return canister.
 - Several student teams built and launched BalloonSat payloads. Four teams launched payloads with the DemoSat program
 - A student team also participated in the annual NASA Great Moon Buggy Competition.
 - Two student teams presented a research paper at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
- COLORADO MESA UNIVERSITY
 - Student teams built robots for the Colorado Robotics Challenge in April 2013.
 - CMU students developed a robotics station for use in the Math Extravaganza event on the CMU campus.
 - CMU students and faculty helped facilitate a robotics summer camp on the campus of the local community college.
- ADAMS STATE UNIVERSITY
 - Facilitated the ASU Robot Society for ASU students and opened to the general public.
 - Student engaged in multiple robotics projects including an autonomous robot for the Colorado Robotics Challenge in April 2013.

- Students and faculty facilitated various lectures and workshops focused on robotics for local schools and the general public.
- Alamosa Mosquito Control District sponsored a project that engaged students designing a more efficient testing “trap”.
- METROPOLITAN STATE UNIVERSITY OF DENVER
 - MSUD teaches an Intro to Space course that is focused on BalloonSats. Students design, build, and launch payloads in one semester – both in the fall and spring semesters.
 - A student team is working on an electric vehicle project with faculty mentors.
 - Students presented a research paper at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
- COMMUNITY COLLEGE OF AURORA
 - In an effort to engage a greater number of students, the CCA Space Grant program has implemented a new class called Engineering 151: Experiment Design. The course is based on design, build, and launch of short-duration balloon payloads. After completion of the course, students will be recruited into more complex space hardware projects, such as long-duration high-altitude balloon or rocket payloads.
 - CCA implemented a transfer program with faculty at Colorado School of Mines. CCA graduating students can gain research experience with a CSM faculty member during the summer prior to entering CSM as an undergraduate student. 1 student has successfully transferred in summer 2012, with plans to continue the program summer 2013.
 - Four student teams presented research posters and papers at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
- COMMUNITY COLLEGE OF DENVER
 - A CCD student team has been developing a balloon satellite payload for launch with the DemoSat program in April 2013.
 - Another group of CCD students is working on developing science activities to engage 4th, 5th, and 6th students in a day of STEM exploration.
- FORT LEWIS COLLEGE
 - A student team designed and built a balloon payload that launched with the summer 2012 DemoSat program.
 - FLC hosted the fall 2012 COSGC Robotics workshop.
 - A student team is working on an autonomous robot for the 2013 Robotics Challenge in April.
 - Students are working with faculty mentors on upgrades to the observatory to make remotely accessible and thereby more accessible by FLC students and faculty.

b. Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).

- COSGC includes:
 - 4 Minority Serving Institutions
 - 5 two-year colleges
 - 3 four-year baccalaureate colleges
 - 3 four-year baccalaureate through masters institutions
 - 5 universities through PhD

- 1 non-profit organization
- 29% of 194 scholarships were awarded to women
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- 80% of 194 scholarships were awarded to undergraduate students
- Of the 352 students participating in Higher Education projects, who did not receive fellowship/scholarship awards:
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 - 6% were from populations underrepresented in STEM disciplines

c. Engage middle school teachers

- The Space Foundation's Summer Space Across the Curriculum courses were held in Colorado Springs and Pueblo, Colorado. A portfolio of **6** courses focusing on science technology, engineering and math are offered as graduate courses for teachers seeking a graduate degree or continuing professional development through university partners that included University of Colorado – Colorado Springs, Regis University, and Colorado State University - Pueblo. **40** teachers participated in the 2012 courses.

d. Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.

- Four high school students participated in UNC's Frontiers of Science Institute (FSI), completing research on rover motion. They then presented posters at the 53rd annual FSI Open House. UNC Space Grant students and faculty mentored the students.
- University of Colorado at Boulder taught the Earth to Space course as part of the CU PreCollegiate Development Program (PCDP) for rising high school seniors June – July 2013.
- Trinidad State Junior College engaged 3 high school students in the robotics project leading up to the Colorado Robotics Challenge. Students are concurrently enrolled in high school and at TSJC.
- Students and faculty at Adams State University (ASU) facilitated a STEM academy on the ASU campus. 18 students from 14 high schools attended. Robotics was an integral part of the camp.

e. Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

- All COSGC community college affiliates have unique programs:
 - Students at **Pikes Peak Community College** are supported as tutors for astronomy and other science classes; the observatory continues to be used for academic classes and general public events; and a student team continues the PPCC BalloonSat effort, launching a payload each spring.
 - Students at **Pueblo Community College (PCC)** – work in teams on autonomous robots, BalloonSat payloads, and machine parts for student teams at other COSGC

- institutions, creating parts for balloonsat payloads, robotics projects, and satellite missions. The student robotics team also presented a paper at the annual Colorado Undergraduate Space Research Symposium.
- **Community College of Denver (CCD)** supports 1 student team each academic semester on a balloon payload as part of the statewide DemoSat effort; and 1 student team that designs activities and facilitates them at an all-day event to get younger students excited about STEM and into CCD.
 - **Trinidad State Junior College (TSJC)** has student teams working on an autonomous robotics project, a BalloonSat mission, and astrophotography, which was also included in the spring 2013 second-semester astronomy course. TSJC robotics and balloon payload students presented research posters at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
 - **Community College of Aurora (CCA)** with the assistance of the COSGC lead institution, has implemented a new course on the CCA campus: Engineering 151-Experiment Design. Students who complete the course will be recruited into a more complex space hardware project such as long-duration balloon or rocket payloads. CCA is hosting the 2013 Colorado Space Grant Undergraduate Space Research Symposium. Finally, CCA has implemented a transfer program in collaboration with Colorado School of Mines to engage graduating CCA students in CSM faculty research the summer prior to their enrollment as CSM undergraduate students in the fall semester. Four student teams presented research posters and papers at the annual Colorado Undergraduate Space Research Symposium (judged by industry mentors).
 - Students and faculty of the Space Grant program at Colorado Mesa University facilitated a robotics and engineering summer camp on the **Western Colorado Community College** campus – hoping to inform students about the programs and opportunities should they transfer to CMU for an 4-year and/or advanced degree.
 - Staff at the Lead Institution provide project mentorship for all community college student projects; teach sections in the CCA Engineering 151 course; facilitate robotics workshops for community college students; facilitate a transfer program to recruit graduating community college students into 4-yr institutions (hoping to expand the program statewide); provide testing facilities for student projects; host tours for community college student groups; and mentor community college affiliate directors through new projects and help make connections with NASA centers and industry.

f. **Aeronautics directly address the fundamental research needs of the Next Generation Air Transportation System (NextGen).**

None.

g. **Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.**

- Students at the University of Colorado at Boulder continue work on the Drag and Atmospheric Neutral Density Explorer (DANDE) mission toward a summer 2013 launch. DANDE is a low-cost density, wind, and composition-measuring satellite that will provide data for the calibration and validation of operational models and improve our understanding of the thermosphere.

- The PolarCube project is a collaboration between COSGC and the National Snow and Ice Data Center. The project has also garnered the interest of NASA's Earth Science Technology Office. PolarCube won an award in the Air Force Office of Scientific Research's University Nanosatellite 8 program. Collaborators for the PolarCube mission also include the Cooperative Institute for Research in Environmental Sciences and the Center for Environmental Technology.
- Several BalloonSat payloads have included missions to sample the atmosphere for heavy metals, pollution, and cosmic radiation.

h. Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.

None.

IMPROVEMENTS MADE IN THE PAST YEAR

- 1) In January 2013, COSGC leadership completed a Mid-Course Improvement Plan in conjunction with the National Space Grant leadership. The plan directly addresses COSGC's current failure to meet standards for inclusion of women and minority students in COSGC programs. Several efforts are in place to enable COSGC to make strides toward inclusion and retention of more women and minority students. These include:
 - New evaluation methods of all COSGC institutions;
 - Expansion of the pilot program to connect community college students transferring to 4-year institutions, to keep them engaged in Space Grant projects;
 - Focused discussions with all COSGC directors and affiliate directors to discuss best practices, obstacles, frustrations, and collaborations; and
 - Engaging with campus organizations established to support underrepresented student retention efforts (i.e. Society of Women Engineers, Multicultural Engineering Program, etc).
- 2) The COSGC budget was reorganized in order to move more base funding to COSGC affiliate institutions that had several years of successful expansion of programming that required additional funds.
- 3) A new strategic plan is in its final draft phase. The plan was created as a collaboration between all COSGC leadership, affiliate directors, and the advisory board.
- 4) The COSGC lead institution is piloting a volunteer program that would enable the engagement of more students in post-secondary space hardware projects with less funding.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

COSGC MEMBER INSTITUTIONS:

- **Adams State University** [formerly Adams State College] (4-year, Baccalaureate & Graduate): Minority Serving Institution; Facilitates students programs that contribute to Outcomes 1 & 3.

- **Colorado Mesa University** [formerly Mesa State College] (University through PhD) Facilitates student programs that contribute to Outcome 1.
- **Colorado School of Mines** (University through PhD): Facilitates student programs that contribute to Outcome 1.
- **Colorado State University** (University through PhD): Facilitates student programs that contribute to Outcome 1.
- **Colorado State University – Pueblo** (4-year Baccalaureate & Graduate): Facilitates student programs that contribute to Outcome 1
- **Community College of Aurora** (2-year college) Facilitates student programs that contribute to Outcome 1.
- **Community College of Denver** (2-year college) Minority Service Institution. Facilitates student programs that contribute to Outcome 1.
- **Fort Lewis College** (4-year Baccalaureate) Facilitates student programs that contribute to Outcome 1.
- **Metropolitan State University of Denver** [formerly Metropolitan State College of Denver] (4-year Baccalaureate and Graduate) Facilitates student programs that contribute to Outcome 1.
- **Pikes Peak Community College** (2-year college) Facilitates student programs that contribute to Outcome 1 and 3.
- **Pueblo Community College** (2-year college) Minority Serving Institution. Facilitates student programs that contribute to Outcome 1 and provides machining support for other COSGC student projects.
- **The Space Foundation** A non-profit organization supporting space activities, space professionals and education. Facilitates student programs that contribute to Outcome 2.
- **Trinidad State Junior College** (2-year college) Minority Serving Institution. Facilitates student programs that contribute to Outcome 1.
- **University of Colorado at Boulder** (University through PhD) Facilitates student programs that contribute to Outcomes 1 and 3 and fulfills duties as Lead Institution.
- **University of Colorado at Colorado Springs** (University through PhD) Facilitates student programs that contribute to Outcome 1.
- **University of Northern Colorado** (University through PhD) Facilitates student programs that contribute to Outcome 1.
- **Western State Colorado University** [formerly Western State College] (4-year Baccalaureate) Facilitates student programs that contribute to Outcomes 1.

COSGC programs are only possible through collaborations with industry; government labs; academic departments, programs, and labs; NASA centers; and non-profit community organizations. These partners provide mentors, hardware donations, launch opportunities, funding, and/or testing facilities. The following is a list of partners that directly contributed to COSGC student projects this award period:

INDUSTRY PARTNERS:

- **Lockheed Martin** – Provides funding for Colorado School of Mines’ student projects; Serves as Chair for the COSGC Advisory Board; Provides testing facilities and funding for student satellite missions at University of Colorado at Boulder; Provides funding for student

project and course supplies at Metropolitan State University of Denver; and judges for the Colorado Undergraduate Space Research Symposium.

- **Ball Aerospace** - Mentors for satellite missions at the University of Colorado at Boulder along with financial support of the Colorado Undergraduate Space Research Symposium.
- **Cement Creek Welding** - Provides robot building assistance to students at Western State Colorado University
- **Gelnair** – Provided electrical components for the student RocketSat mission.
- **Howl Woodworks** – Mentoring and machining/construction support for Trinidad State Junior College robotics students
- **Analytical Graphics, Inc.** – Site licenses for Satellite Toolkit software used by students at University Colorado for satellite missions; Provides free workshops for students; Speaker at University of Colorado at Boulder course.
- **Composite Technology Development** – Serves on COSGC Advisory Board; Provide financial support and mentors for University of Colorado at Boulder student sounding rocket payload project.
- **Advanced Circuits** – Providing electronic components for the student ALL-STAR CubeSat mission.
- **SparkFun Electronics** – Support of statewide robotics endeavors including access to hardware and mentors for projects statewide.
- **Sierra Nevada Corporation** – Mentors for satellite missions at the University of Colorado at Boulder; provides test facilities for space hardware missions; donates hardware; and provides judges for the Colorado Undergraduate Space Hardware Symposium.
- **RoadNarrows Robotics** – Provides mentors for University of Northern Colorado students as they design, build, and program autonomous robots.
- **Southwest Research Institute** – Mentors for long-duration high altitude balloon payloads at the University of Colorado at Boulder and provides internships for post-secondary students.
- **Parallax Inc.** – Provides web-based training beta tested by Trinidad State Junior College (TSJC) students. Provides hardware, mentorship, training, and software for the TSJC robotics team.
- **Northrup Grumman** – Provides mentors for satellite missions at the University of Colorado at Boulder; provides funding in support of the Space Foundation's efforts at expanding their space exhibits for K-12 students and the general public; and provides judges for the Colorado Undergraduate Space Research Symposium.
- **Black Sun Solar** – Provides internship opportunities for post-secondary students.
- **Equinox Interscience** – Provides mentors for satellite missions at the University of Colorado at Boulder.
- **Horizon Prosthetics** – Provide hardware and mentors for student researchers at University of Colorado at Colorado Springs.
- **KRDO News Channel 13** – Provides a lecturer for the Space Weather and Meteorology course for teachers in the Space Across the Curriculum courses at the Space Foundation.
- **Instar Engineering** – Provides mentors for satellite missions at the University of Colorado at Boulder.
- **Pioneer Astronautics Corp** – Provides mentors for student projects at Colorado State University – Pueblo.

- **BroadReach Engineering** – Collaborating with Colorado School of Mines team to develop a DemoSat payload.
- **Bodine Electric** – Provides hardware donations for student projects at Metropolitan State University of Denver.
- **SKC Inc.** – Provides hardware and mentors for an air sample experiment on a Community College of Denver student balloon payload.
- **Xilinx** – Provides software donation for student satellite missions at University of Colorado at Boulder.
- **AeroFlex** – Provides hardware donations for student satellite missions at University of Colorado at Boulder.
- **Apex Software** – Provides software donations for student satellite missions at University of Colorado at Boulder.
- **Bro Software House** – Provides software donations for student satellite missions at University of Colorado at Boulder.
- **ABSL Space Products** – Provides financial support and judges for the Colorado Undergraduate Space Research Symposium.
- **AMERGINT Technologies** – Provides judges for the Colorado Undergraduate Space Research Symposium.
- **SpaceX** – Provides mentors for the DANDE satellite mission along with the launch of the satellite. Also provides judges and keynote speaker for the Colorado Undergraduate Space Research Symposium.
- **LGS Innovations** – Provides mentors for student satellite missions at University of Colorado at Boulder and judges for the Colorado Undergraduate Space Research Symposium.
- **FirstRF** – Provides financial support of and judges for the Colorado Undergraduate Space Research Symposium.
- **Golder Associates** – Provides judges for the Colorado Undergraduate Space Research Symposium.
- **Surrey Satellite Technology** – Provides judges for the Colorado Undergraduate Space Research Symposium.

ACADEMIC PARTNERS:

- **Center for Astrophysics & Space Astronomy** – Mentors for long duration, high altitude balloon student project at University of Colorado at Boulder.
- **Montana Space Grant Consortium** – Serves on COSGC Advisory Board.
- **Virginia Space Grant Consortium** – Collaborates on RockOn! Workshop.
- **University of Colorado at Boulder (CU) Electrical, Computer, and Energy Engineering Department** – Provided senior design experience to develop the new PolarCube CubeSat mission.
- **CU, Aerospace Engineering Department** – Provides mentors for CU student satellite missions.
- **CU, Mechanical Engineering Department** – Provided senior design experience to develop the propulsion system for the ALL-STAR mission.
- **CU, College of Engineering and Applied Science Dean's Office** – Provided cost match dollars used to support travel, student projects, and general CU Space Grant operations.

- **Laboratory for Atmospheric and Space Physics** – provides mentors for the Trinidad State Junior College BalloonSat team.
- **Red Rocks Community College** – Provided mentorship and curriculum tools for the development of the Colorado Night Sky III Course at Pikes Peak Community College.
- **Trinidad State Junior College (TSJC) Gunsmithing Department** – Provides mentors and use of machining tools and machines for the TSJC robotics and balloon payload teams.
- **Pikes Peak Community College (PPCC) Biology Department** – Continues to provide mentors for the science mission on the PPCC BalloonSat payload.
- **University of Michigan** – Provides collaboration with graduate research at Colorado State University, Fort Collins.
- **Colorado State University, Fort Collins (CSU)** – Provides mentors and testing facilities for robotics and balloon payload student projects at CSU Space Grant.
- **Colorado School of Mines (CSM), Engineering Department** – Provides mentors for summer CSM student research.
- **CSM, Geophysical Engineering Department** – Provides mentors for CSM summer student research.
- **Integrated Teaching and Learning Laboratory, University of Colorado at Boulder (CU)** – Provides machining, electronics, and software for CU student projects.
- **Colorado Mesa University, Department of Engineering** – Provides mentors for CMU Space grant robotics projects.
- **Adams State University (ASU) Title V Grant** – Provides funding and mentors for the STEM Academy at ASU.
- **Trinidad State Junior College, Alamosa Campus** – Collaboration on robotics lectures with students and faculty at Adams State University.
- **Adams State University (ASU) Department of Chemistry, Computer Science, and Mathematics** – Mentors for ASU student projects.
- **ASU Communications Department** – Sponsors ASU Space Grant website and helps manage Github for ASU student projects.
- **Community College of Aurora (CCA) Biology Department** – Faculty mentors for CCA student projects.
- **CCA Chemistry Department** – Faculty mentors for CCA student projects and lecturer for CCA engineering course.
- **Colorado School of Mines (CSM), Physics Department** – Collaborating with Community College of Aurora (CCA) on a pilot program to provide CCA students with research experience and financial support for transferring to CSM to complete a bachelors or advanced degree; Guest lecturer in a CCA Engineering course.
- **Pueblo Community College** – Provides students and machining resources to machine parts for student projects at multiple COSGC institutions to support space hardware missions.
- **Colorado State University, Biology Department** – Provided zebra fish embryo for student projects at Community College of Denver.
- **Sonoma State University** – collaborating with faculty at Fort Lewis College in the effort to make the observatory remotely accessibly.
- **Fort Lewis College (FLC), Information Technology Department** – provided mentors for the FLC observatory project.

- **FLC, Science Lab Coordinator** – Provides support to student teams working on robotics at FLC.
- **The Center for Environmental Technology** – Provides mentors for the PolarCube mission at University of Colorado at Boulder.
- **Cooperative Institute for Research in Environmental Sciences** – Provides financial support for student BalloonSat mission at University of Colorado at Boulder.

GOVERNMENT PARTNERS:

- **NASA Langley Research Center** (Aerospace Technologist, Laser Remote Sensing Branch) – Mentoring student research team on Laser Sensor project at Colorado State University
- **NASA's Wallops Space Flight Center** – Provides launch support for RockOn! Workshop and RockSat-C and –X student payloads programs.
- **NASA's Earth Science Technology Office** – Provides mentors for the new PolarCube CubeSat mission.
- **NASA Jet Propulsion Laboratory** – Provide speakers in courses at University of Colorado at Boulder and judges for the Colorado Undergraduate Space Research Symposium.
- **Air Force Office of Scientific Research** – Provides mentors for the DANDE satellite mission at University of Colorado at Boulder.
- **Air Force Space Command Space Analysis Center (A9A)** – Provides mentors for the DANDE satellite mission at the University of Colorado.
- **National Snow & Ice Data Center** – Providing mentors and mission development for the PolarCube mission.
- **National Oceanic and Atmospheric Association** – provides lectures and field trips for teachers in the Space Across the Curriculum courses at the Space Foundation; Provides mentors for BalloonSat mission at Pueblo Community College.
- **National Center of Atmospheric Research** – provides lectures and field trips for teachers in the Space Across the Curriculum courses at the Space Foundation.
- **United States Geological Survey** – provides the lead instructor for the Earth System Science course for teachers in the Space Across the Curriculum courses at the Space Foundation.
- **Air Force Research Laboratory** – Provides research collaboration with graduate research project at Colorado State University, Fort Collins. Provides mentors and testing facilities for the University of Colorado at Boulder (CU) DANDE satellite mission and mentors for the CU PolarCube mission.

NON-PROFIT COMMUNITY PARTNERS:

- **Edge of Space Sciences** – Provides balloon payload launches to statewide program.
- **Louis Stokes - Colorado Alliance for Minority Participation** - Provides financial support to students working on Space Grant projects at Trinidad State Junior College and Colorado State University – Pueblo.
- **Gunnison Valley Observatory** – Provides astronomical observing facilities for Western State Colorado University student and faculty projects.
- **Colorado Springs Astronomical Society** – Continue to provide many facilitators for multiple star parties on the PPCC campus throughout the year.
- **The Mars Society** – provides mentors for students working on the Sabatier reactor at Colorado State University – Pueblo.

- **John McConnell Math & Science Center** – Collaborates with students and faculty at Colorado Mesa University to provide STEM opportunities to K-12 students, teachers, and the general public.
- **San Luis Valley Board of Cooperative Services** – Collaborates on robotics workshops with students and faculty at Adams State University.
- **Alamosa Mosquito Control District** – Provided mentorship and collaboration on a student project at Adams State University.
- **Durango Discovery Museum** – Collaborates with Fort Lewis College students to facilitate star parties for the general public.
- **Great Sand Dunes National Park** – Provides the venue for the annual Colorado Robotics Challenge and provides resources during planning of the event.
- **Colorado Space Business Roundtable** – Provides financial support for the Colorado Undergraduate Space Research Symposium.

The National Space Grant Office requires two annual reports, this Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.